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Jawaharlal Nehru

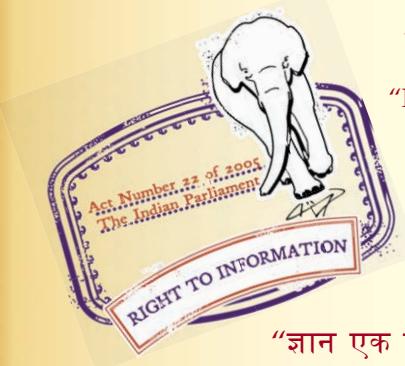
“Step Out From the Old to the New”

IS 5047-2 (1979): Glossary of Terms Relating to Aluminium and Aluminium Alloys, Part II: Plant and Operations, Thermal Treatment, Control and Testing, Finishing [MTD 7: Light Metals and their Alloys]

“ज्ञान से एक नये भारत का निर्माण”

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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartṛhari—Nītiśatakam

“Knowledge is such a treasure which cannot be stolen”



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Indian Standard
GLOSSARY OF TERMS
RELATING TO ALUMINIUM AND
ALUMINIUM ALLOYS

PART II PLANT AND OPERATIONS, THERMAL
TREATMENT, CONTROL AND TESTING, FINISHING

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GLOSSARY OF TERMS RELATING TO ALUMINIUM AND ALUMINIUM ALLOYS

PART II PLANT AND OPERATIONS, THERMAL TREATMENT, CONTROL AND TESTING, FINISHING

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Indian Standard

GLOSSARY OF TERMS RELATING TO ALUMINIUM AND ALUMINIUM ALLOYS

PART II PLANT AND OPERATIONS, THERMAL TREATMENT, CONTROL AND TESTING, FINISHING

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 23 July 1979, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard (Part II) has been prepared to making the glossary of terms for application in the aluminium industry more comprehensive by including the terms connected with special types of wrought metals, plant and operations, thermal treatment, control and testing, finishing, geometrical properties and tolerance, structural and surface defects, etc. It is hoped that this comprehensive standard on glossary of terms for aluminium and its alloys will help in establishing a generally recognized usage for various terms encountered in the aluminium industry and eliminate any confusion which may sometimes arise due to individual interpretation of terms used in the industry.

0.3 This standard is being issued in three parts covering different subjects in a logical sequence. This part dealing with plant and operations, thermal treatment, control and testing, and finishing forms Part II of the series. The other parts in the series are as given below:

- Part I Unwrought and wrought metals (main and special types)
- Part III Geometrical properties and tolerance, structural and surface defects

0.4 In the preparation of this standard assistance has been derived from the following:

BS 3660 : 1963 Glossary of terms for aluminium and aluminium alloys. British Standards Institution.

Nomenclature for aluminium mill products. The Aluminium Association of USA.

1. SCOPE

1.1 This standard (Part II) defines commonly used terms in the aluminium industry relating to plant and operations, thermal treatment, control and testing, and finishing.

2. TERMS AND DEFINITIONS

2.1 Plant and Operations

2.1.1 *Chill Casting* — A process in which molten metal is poured into a permanent mould and solidified.

2.1.2 *Direct Chill (D.C.) Continuous Casting* — A process in which liquid metal is solidified rapidly in a short water-cooled metallic mould or die and continuously withdrawn and cut to length whilst the mould is being simultaneously replenished with liquid metal.

2.1.3 *Direct Chill (D. C.) Semi-continuous Casting* — A process in which liquid metal is solidified rapidly in a short water-cooled metallic mould or die and continuously withdrawn until the required length has been produced, when casting is discontinued.

2.1.4 *Homogenizing* — Prolonged heating of billets, slabs, etc, to achieve the uniform distribution of the soluble constituents.

2.1.5 *Cropping* — The removal by shearing or sawing, of the ends of cast or semi-fabricated products at an intermediate stage of processing.

2.1.6 *Breaking-Down* — The initial hot-working operation whereby heavy reduction is given to slabs or cast forging stock.

2.1.7 *Scalping* — The surface machining of billets, forging stock, slabs and wirebars preparatory to their fabrication.

2.1.8 *Sheet Mill* — A mill used for cold rolling either plate or sheet.

2.1.9 *Strip Mill* — A mill with coiling equipment, employed for the continuous cold rolling of strip.

2.1.10 *Hot Rolling* — The reduction of thickness or cross-sectional area of slabs and wirebar by rolling at temperature usually at or above the lower limit of the recrystallization temperature range.

2.1.11 *Cold Rolling* — The reduction of thickness of plate, sheet and strip by rolling at temperature below the recrystallization temperature range.

2.1.12 *Temper Rolling* — Controlled reduction by cold rolling to develop the required mechanical properties.

2.1.13 Pack Rolling — Rolling two or more thin sheets simultaneously through the same pass.

2.1.14 Slitting — The cutting of strip into two or more widths by the use of rotary shears.

2.1.15 Shearing — The cutting of metal by the use of a press or guillotine.

2.1.16 Press — A general term for machine employing pressure to deform or shear metal.

2.1.17 Press Brake — A power-operated single action press used for bending plate or sheet.

2.1.18 Blanking Press — A press used for shearing blanks from plate, sheet or strip.

2.1.19 Blanking — The production of circles and other shapes by shearing on blanking press.

2.1.20 Blanking Die — A die used for shearing circles and other blanks.

2.1.21 Extrusion Press — A machine consisting essentially of a container, a ram and a die used for the production of extrusions.

2.1.22 Direct Extrusion — A process in which a billet is placed in a container and under pressure from a ram is forced through a stationary die.

2.1.23 Indirect Extrusion — A process whereby a moving die located at the end of a hollow ram is forced against a stationary billet.

2.1.24 Impact Extrusion — A process in which extrusion is effected by a sudden blow.

2.1.25 Extrusion Die — A block of special steel having one or more holes of the required contour through which a billet is forced.

2.1.26 Single-Hole Die — An extrusion die having only one hole.

2.1.27 Multi-Hole Die — An extrusion die having more than one hole.

2.1.28 Porthole Die, Bridge Die — An extrusion die which incorporates a mandrel as an integral part of the die assembly. It is used to provide extruded hollow products from solid billets.

2.1.29 Container — The cylinder with a round or rectangular bore, through which the billet is extruded in an extrusion press.

2.1.30 Extrusion Ratio — The ratio of the cross-sectional area of the extrusion container to that of the extruded section.

2.1.31 *Mandrel* — A steel insert within the die orifice controlling the internal form of hollow products during extrusion or drawing.

2.1.32 *Fixed Mandrel* — A tapered mandrel attached to the main extrusion ram. As the latter moves forward the mandrel passes through the hollow billet and die giving a product slightly tapering in wall thickness along the length.

2.1.33 *Piercing Mandrel* — A fixed mandrel used in conjunction with an auxiliary ram to pierce solid billets and thereafter to serve as an arrested mandrel.

2.1.34 *Arrested Mandrel* — A tapered mandrel attached to an auxiliary extrusion ram. As the main ram moves forward the tapered mandrel is held stationary in the die, resulting in a product of uniform wall thickness along the length.

2.1.35 *Floating Mandrel* — A tapered mandrel which is not attached to the main extrusion ram and which is left free to centre itself in a hollow billet. The resulting product tapers slightly in wall thickness along the length.

2.1.36 *Discard* — That portion of a billet which is left unextruded.

2.1.37 *Drawing* — Working material on all surfaces to effect reduction in cross-sectional area, by pulling it through a die.

2.1.38 *Temper Drawing* — Controlled reduction by drawing to develop the required mechanical properties.

2.1.39 *Bull Block* — A power driven drum used for drawing rod wire or tube through a die.

2.1.40 *Draw Bench* — A machine for drawing bars, rods, sections, shaped tube and tube in straight lengths.

2.1.41 *Drawing Die* — A plate or block of special steel, or block containing a hard insert, which is pierced by a hole of the required contour through which the metal is pulled.

2.1.42 *Pointing (Tagging)* — Reducing one end of a rod, bar, tube or wire to a size capable of passing through a drawing die.

2.1.43 *Drawing Plug (Draw Bulb)* — A plug used in drawing tube to control the internal dimensions.

2.1.44 *Sinking (Sinking Pass)* — The reduction of the outside diameter of tube by pulling it through a die without using a draw plug or mandrel.

2.1.45 *Tube Reducing* — The production of tube from tube bloom by rolling on a mandrel.

2.1.46 Turks-Head Die — Four adjustable undriven rollers arranged at right angles to serve as a die for the drawing of square or rectangular sections from rod or wire.

2.1.47 Flattening Mill — A machine consisting essentially of driven pairs of rollers used in the production of flattened wire.

2.1.48 Rod Mill — A mill used for the production of hot rolled rod.

2.1.49 Shaving — The drawing of hot rolled rod, tube, or wire through a die with a cutting edge in order to remove a thin layer from its surface.

2.1.50 Drop Hammer — A forging machine in which the force of the blow is derived from a free-falling weighted top die.

2.1.51 Tup — The heavy moving portion of the drop stamp carrying the top die.

2.1.52 Moulding Die (Preforming Die) — A die which shapes the stock prior to forging between closed dies.

2.1.53 Open Die — A forging die with a flat face, that is, a die into which no impression has been cut.

2.1.54 Closed Die — Forging dies, used in pairs, into which impressions have been cut to impart the required shape.

2.1.55 Swageing Die — Forging dies used in pairs, through which stock is worked by a hammering action, circular cross-section of the material being thereby reduced.

2.1.56 Clipper Die (Trimmer Die) — A die used for removing the flash from stampings.

2.1.57 Finishing Die — A die used during the final forging operation.

2.1.58 Drawing-Out — Increasing the length and reducing the cross-sectional area of forging stock by working under a hammer or press.

2.1.59 Upsetting — A method of working forging stock in order to increase its cross-sectional area.

2.1.60 Dummy Forging — The rough hand forging of stock destined for forging to shape in closed dies.

2.1.61 Dummy — A rough hand forging destined for forging to shape in closed dies.

2.1.62 Moulding — Preliminary die-shaping prior to forging between closed dies.

2.1.63 Swageing — The reduction of the circular cross section of stock by a hammering or squeezing action.

2.1.64 Stamping — The shaping of sheet or forging stock between closed dies on a drop hammer.

2.1.65 Coining — A final cold forging operation applied to obtain close tolerances.

2.1.66 Pressing — The shaping of sheet or forging stock between closed dies on a mechanical or hydraulic press.

2.1.67 Clipping — The removal of the flash from drop stampings and pressings.

2.1.68 Fettling (Dressing) — The removal of unwanted metal from a forging at any stage of production.

2.1.69 Trimming — The removal of excess metal from the edges of a semi-fabricated product.

2.1.70 Tonghold — A projection of unworked metal on a forging to facilitate manipulation during processing.

2.1.71 Milling — A machining process in which metal is removed by a revolving multi-edged cutter to provide flat or profile surfaces.

2.1.72 Punching — The removal of metal from rolled or extruded products by perforating.

2.1.73 Cladding — A process whereby a thin layer of aluminium or aluminium alloy is metallurgically bonded to the core.

2.1.74 Rectification — The correction of irregularities.

2.1.75 Stretching — The levelling of rolled materials or the straightening of extruded or drawn materials by imparting the minimum permanent extension required to remove distortion.

2.1.76 Controlled Stretching — Stretching to effect a minimum specified permanent extension (percentage permanent set) in order to relieve internal stresses and to minimize distortion during machining.

2.1.77 Roller Levelling (Flattening) — The flattening of plate or sheet by passing it between a series of staggered rollers of small diameter.

2.1.78 Detwisting — An operation designed to remove torsional deviations from the transverse axis along the length of an extrusion.

2.1.79 Reeling — The straightening by rotary and flexing action of round bar, rod or tube by passing it through offset driven rollers.

2.1.80 Straightening — The removal of longitudinal distortion.

2.1.81 Roller Straightening — The straightening of an extrusion (other than round) by passing it through a series of staggered rollers of small diameter.

2.1.82 Spinner Straightening and Cutting — The automatic straightening and cutting to length of coiled wire by feeding it through a machine consisting of rotating offset dies in tandem with a pair of cropping dies.

2.1.83 Oiling — The application of oil to products to provide temporary protection against atmospheric attack during transit and during storage.

2.1.84 Degreasing — The removal of oil or grease usually by a suitable organic solvent or an aqueous detergent.

2.1.85 Interleaving — The practice of protecting the surface of plate, sheet and strip by separating adjacent surfaces by suitable paper.

2.1.86 All-Over Marking — A method of identifying sheet, plate and strip by printing at close intervals over the surface the name of the manufacturer, the relevant specification number and in some cases the temper of the material.

2.1.87 Spinning — A method for making articles, having rotational symmetry, from circular sheet blanks, by mounting in a lathe and slowly forming it into shape, as it rapidly rotates about its axis, through pressure applied by tools.

2.1.88 Spinning Lathe — An equipment for making articles by spinning.

2.2 Thermal Treatment

2.2.1 Full Heat Treatment — Solution treatment followed by precipitation treatment.

2.2.2 Solution Treatment — Heating at a prescribed temperature followed by rapid cooling (quenching) as a prelude to natural ageing or precipitation heat treatment.

2.2.3 Precipitation Treatment (Artificial Ageing) — The controlled heating of solution heat treated material above room temperature for required duration in order to increase its hardness, proof stress and tensile strength.

2.2.4 Quenching — Rapid cooling from the solution treatment temperature by contact with water, air or oil.

2.2.5 Die Quenching (Press Quenching) — The quenching of an extrusion at the press as it leaves the die.

2.2.6 Natural Ageing (Age Hardening) — The increase in hardness and tensile properties and reduction in ductility which occurs at room temperature after the solution treatment and quenching of most heat treatable alloys. The change in properties is substantially complete within four to five days.

2.2.7 Stabilizing — A low temperature treatment applied to cold worked aluminium-magnesium alloys to provide mechanical properties which will remain constant.

2.2.8 Recrystallization — The replacement of cold-worked metal grain by new strain-free grains, effected by heating metal to and holding at a suitable temperature.

2.2.9 Stress Relieving — Heating below the recrystallization temperature with the object of reducing internal stresses set up in a material as a result of previous operations.

2.2.10 Annealing — The softening of material by heating to and holding at a temperature sufficient to cause recrystallization.

2.2.11 Flash Annealing — Annealing involving rapid heating to the annealing temperature, with the primary object of ensuring fine grain size.

2.2.12 Super Annealing — The annealing of heat treatable alloys, followed by a slow controlled rate of cooling to produce a condition of maximum ductility with a minimum tendency to natural ageing.

2.2.13 Partial Annealing (Temper Annealing) — The low temperature treatment of cold-worked material to effect limited softening without causing recrystallization. This treatment is used to obtain certain intermediate tempers.

2.2.14 Differential Annealing — The heating of blanks so that the peripheral annulus or other specified parts only are annealed.

2.2.15 Age Softening — The loss of strength and hardness at room temperature which takes place in certain alloys due to spontaneous reduction of residual stresses in the strain hardened structure.

2.3 Control and Testing

2.3.1 Batch or Lot — A quantity of material of the same specification and size produced and/or processed at the same time.

2.3.2 Cast

- a) The product of one furnace melt, or of one crucible melt.
- b) The product of a number of either crucible melts or furnace melts mixed prior to casting.

c) The amount of metal tapped from the furnace without any further addition of metal having been made when a continuous melting process is used.

2.3.3 Heat-Treatment Batch — A quantity of material of one alloy of the same dimensions and produced in the same way, solution-treated and subsequently precipitation-treated in one furnace load. More than one heat-treatment batch may comprise a furnace load.

2.3.4 Control Bar — A test bar in a given alloy, of known response to heat-treatment, which is included in a furnace load to check the effectiveness of the heat-treatment operation.

2.3.5 First-Off Forging (Proof Forging) — An initial sample made from new dies and used for checking dimensional and metallurgical quality.

2.3.6 Integral Test Piece — A tensile test sample produced integrally with the forging.

2.3.7 Tonghold Test Piece — A tensile test sample taken from the tong-hold of a forging.

2.3.8 Directional Properties — The mechanical properties of a product in various directions with respect to the grain flow.

2.3.9 Longitudinal Properties — Mechanical properties parallel to the grain flow.

2.3.10 Transverse Properties — Mechanical properties along the major axis at right angles to the grain flow.

2.3.11 Short Transverse Properties — Mechanical properties along the minor axis at right angles to the grainflow.

2.3.12 Hardness Test — A test in which the resistance to deformation is determined by relating to the load applied to an indenter of prescribed form, the depth (Rockwell), or surface area (Brinell and Vickers), of the impression produced.

2.3.13 Tensile Test — A test in which the test piece is stressed in tension, generally until fracture, to determine one or more of its tensile properties.

2.3.14 Tensile Strength — The maximum load in the tensile test, divided by the original cross-sectional area of the test piece.

2.3.15 Proof Stress — The stress which produces, while the load is still applied a non-proportional extension equal to a specified percentage of the gauge length.

2.3.16 Gauge Length — The length of the selected part of the unstrained test piece to which any increase in length is referred.

2.3.17 Percentage Elongation — The permanent extension (after fracture) of the gauge length expressed as a percentage of the original gauge length.

2.3.18 Bend Test — The bending of a specimen to conform with a pre-determined radius and angle, to assess bending characteristics and ductility.

2.3.19 Bend Radius — The radius of curvature of the former around which a specimen is bent.

2.3.20 Shear Test — A test in which the test piece is stressed in shear until fracture to determine its shear strength.

2.3.21 Bore Test — A test tube to verify freedom from constriction by passing a metallic bob or wire of specified diameter through the tube.

2.3.22 Drift Test (Drift Expansion Test) — The diametral expansion of the end of a tube sample to a predetermined amount by the insertion of a cone to assess, for example, suitability for end expansion.

2.3.23 Flanging Test — A test in which a disc-shaped rim of predetermined size is formed at the end of a tube sample to assess its suitability for the manufacture of tubular rivets.

2.3.24 Pressure Test — A hydraulic or pneumatic test applied to extruded or drawn tube to ensure that the material will withstand a specified pressure for a specified time without leakage or distortion.

2.3.25 Flattening Test — A test in which circular, square, or 'streamlined' tube is flattened until the diameter, diagonal or major axis is reduced to a predetermined value.

2.3.26 Torsion Test — A test in which a sample is twisted axially for a given number of revolutions.

2.3.27 Wrapping Test — Wire under test is wrapped round a wire or mandrel of its own diameter to form a close helix for a specified number of turns, then partly unwrapped for a specified number of turns and then rewrapped to the original number of turns in the same direction as the first wrapping.

2.3.28 Cut-Up Test — A destructive test carried out on forgings to verify details of the grain flow and mechanical properties in various positions in the forgings.

2.3.29 Grain Size — The mean size of metal crystals expressed in terms of the number of grains (metal crystals) per unit area or as the mean grain diameter.

2.3.30 Fracture Test — A qualitative test in which a piece of metal is notched and broken, and the fracture surface examined in order to assess grain structure and freedom from defects.

2.3.31 Etching Test — The treatment of the cross-section of a sample using a chemical reagent to reveal the macro-structure of the metal.

2.3.32 Dye Penetrant Test — A non-destructive test in which clean and degreased material is immersed in or covered by a dye penetrant for a requisite period. After the residual superficial penetrant has been removed and a developer applied, the dye seeps out from any flaws and cracks.

2.3.33 Fluorescent Penetrant Test — A dye penetrant test using a fluorescing dye with subsequent examination of the dried material under ultra-violet radiation.

2.3.34 Anodizing Test — A non-destructive test in which degreased material is chromic acid anodized and rinsed. If cracks or other superficial flaws are present they retain some of the chromic acid solution which subsequently seeps out and stains the anodic film.

2.3.35 Cupping Test — A mechanical test used to determine the ductility and drawing properties of sheet metal. It consists in measuring the maximum depth of bulge (or cup) which can be formed before fracture.

2.3.36 Ultrasonic Test — A non-destructive test employing high frequency sound waves for the location and assessment of size of internal defects.

2.3.37 Eddy Current Test — A non-destructive test which can be used for the assessment of a number of characteristics, for example, internal soundness and thickness of anodic film.

2.3.38 Electrical Resistivity (Volume Resistivity) — The resistance between opposite faces of a unit cube of a given material at a given temperature.

2.3.39 Electrical Conductivity — The reciprocal of volume resistivity. Electrical conductivity is often expressed in terms of percentage of the international annealed copper standard. (IACS).

2.3.40 Endurance Limit — The limiting stress below which a material will withstand a specified large number of cycles of stress.

2.3.41 Modulus of Elasticity — The ratio of stress to corresponding strain throughout the range where they are proportional.

2.3.42 Modulus of Rigidity — The ratio of the unit shear stress, in a torsion test, to the displacement caused by it per unit length in the elastic range. This modulus corresponds to the modulus of elasticity in the tension test.

2.3.43 Strain Hardening — Modification of a metal structure by cold working resulting in an increase in strength and hardness with loss of ductility.

2.4 Finishing

2.4.1 Scurling — Grinding with a coarse abrasive to remove superficial defects usually preparatory to further processing.

2.4.2 Tumbling — The treatment of articles in a rotating container for deburring or to provide a variety of surface textures.

2.4.3 Buffing — Polishing with a flexible rotating mop carrying an abrasive compound.

2.4.4 Brightening — The treatment of articles to improve their specular reflectivity.

2.4.5 Chemical Brightening — Brightening by chemical means.

2.4.6 Electro-Brightening — Brightening by electro-chemical means.

2.4.7 Grit Blasting — The projection of abrasive grit so as to strike the surface of an article, providing a cleaning action and producing a matt finish.

2.4.7.1 Sand blasting — The projection of sand/quartz particles so as to strike the surface of an article providing a cleaning action and producing a matt finish.

2.4.8 Vapour Blasting — The projection of a mixture of abrasive grit, water and air to strike the surface of an article, providing a cleaning action and producing a satin finish.

2.4.9 Etching — The production of a uniform matt finish by controlled chemical or electro-chemical attack.

2.4.10 Acid Etching — Etching using an acid solution.

2.4.11 Caustic Etching — Etching using a caustic alkali solution.

2.4.12 Chemical Conversion Coating (Prepainting Treatment, Chemical Conversion, Wash Priming, Etch Priming) — Treatment of material with chemical solutions, used as a prepainting treatment or for preparing the surface for special application.

2.4.13 Pre-treatment Priming (Etch Priming), Wash Priming — The application of a solution containing a resin, a chromate and an acid which is allowed to dry on and provide the key for subsequent painting.

2.4.14 Priming — The application of a priming paint, often pigmented with a corrosion inhibitor such as zinc chromate after suitable pre-treatment.

2.4.15 Anodizing — An electro-chemical method of producing an oxide film of controlled thickness and predetermined characteristics. The anodic film is applied to improve resistance to corrosion and abrasion and to provide an electrically insulating surface or a base for a decorative finish. The oxide film may be coloured by using organic dyes or inorganic pigments or by electrolytic colouring in metal salt solution.

2.4.16 Sealing of Anodic Coatings — A treatment applied after anodizing to reduce porosity and/or absorptivity of the coating.

2.4.17 Hard Anodizing — Anodizing under special conditions to provide a dense hard film offering extremely high resistance to abrasion.

2.4.18 Chromic Acid Anodizing — Anodizing using a chromic acid electrolyte.

2.4.19 Oxalic Acid Anodizing — Anodizing using an oxalic acid electrolyte.

2.4.20 Sulphuric Acid Anodizing — Anodizing using a sulphuric acid electrolyte.

2.4.21 Mirror Finish — A rolled or polished finish with high specular reflectivity.

2.4.22 Frosted Finish — A white slightly specular finish produced by etching.

2.4.23 Matt Finish — A diffuse finish usually produced by etching, scratch brushing or sand blasting.

2.4.24 Grey Plate Finish — A matt finish produced by a special rolling technique.

2.4.25 Satin Finish — A fine textured matt finish.

2.4.26 Scratch-Brushed Finish — A matt or satin finish produced by abrasion with rotating wire brushes.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 26 60 21, 27 01 31

Telegrams : Manaksanstha

Regional Offices :

Telephone

Western : Novelty Chambers, Grant Road

ROMBAY 400007

37 97 29

Eastern : 5 Chowinghee Approach

CALCUTTA 700072

23-08 02

Southern : C. I. T. Campus, Adyar

MADRAS 600020

41 24 42

Branch Offices :

'Pushpak', Nurmohamed Shaikh Marg, Khanpur	AHMADABAD 380001	2 03 91
'F' Block, Unity Bldg, Narasimharaja Square	BANGALORE 560002	2 76 49
Gangotri Complex, Bhadbhada Road, T.T. Nagar	BHOPAL 462003	6 27 16
22E Kalpana Area	BHUBANESHWAR 751014	5 36 27
Ahimsa Bldg, SCO 82-83, Sector 17C	CHANDIGARH 160017	2 83 20
5-8-56C L. N. Gupta Marg	HYDERABAD 500001	22 10 83
D-277 Todarmal Marg, Banipark	JAIPUR 302006	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	8 12 72
Patliputra Industrial Estate	PATNA 800013	6 28 08
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	32 27